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DETAILED DESCRIPTION

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[Detailed Description of the Invention]

[0001]

[Field of the Invention] With respect to the driving gear of a plasma display, the subfield conversion approach of a plasma display, and plasma display equipment, especially this invention divides 1 field period of a video signal into two or more subfields, and relates to the driving gear of the plasma display which displays gradation with the combination of this subfield, the subfield conversion approach of a plasma display, and plasma display equipment.

[0002]

[Description of the Prior Art] When expressing the gradation of an image in a plasma display conventionally, the 1 field is divided into two or more subfields, the count of lighting of each cel within 1 subfield period and lighting time amount are changed, and gradation is reproduced.

[0003] When performing color display of 256 gradation, as shown in drawing 7, the 1 field can be divided into eight subfields SF1, SF2, SF3, SF4, SF5, SF6, SF7, and SF8, and the thing corresponding to 1, 2, 4, 8, 16, 32, and 64,128 made to emit light by the count of luminescence, then the combination of a subfield can perform color display of 256 gradation in a subfield, respectively. For example, for considering as brightness with 18 gradation, a pixel is chosen in subfields SF2 and SF5, and a pixel is not chosen in the other subfield.

[0004] There are some which were indicated by JP,11-119729,A as an example of the plasma display equipment which performs the above gradation displays. In this official report, the subfield of various spacing respectively generated at the specific time of day in a frame as criteria in a Vertical Synchronizing signal is generated, and the configuration which performs the above-mentioned gradation display based on the timing signal of a subfield is indicated.

[0005]

[Problem(s) to be Solved by the Invention] By the way, a plasma display has the technical problem that the brightness of each cel decreases, when the number of cels to turn on, i.e., lighting area, increases.

[0006] The discharge current of the whole panel increases, the electrical potential difference of an electrode falls with the impedance of the electrode in each cel, and this is considered for the discharge current of each cel to decrease conversely according to this phenomenon, when the number of cels to turn on increases.

[0007] According to this phenomenon, the brightness of each subfield will change with the numbers of lighting cels of a subfield, a gradation property becomes nonlinear also in the gradation display mentioned above, and the reversal of gradation will occur depending on the case.

[0008] In the present condition, it is a measure for this problem. Direct measures are not taken against a drive circuit, but a video signal is processed and indirect measures, such as performing property amendment, are taken.

[0009]

[Means for Solving the Problem] The driving gear of the plasma display of this invention In the driving gear of the plasma display which divides 1 field period of a video signal into two or more subfields, and

displays gradation with the combination of this subfield It is characterized by having a count means to count the number of lighting pixels in each subfield, a means to decide the amount of brightness amendments based on the number of lighting pixels in each counted subfield, and a means to determine the maintenance pulse number of each subfield according to this amount of brightness amendments.

[0010] Moreover, the driving gear of the plasma display of this invention In the driving gear of the plasma display which divides 1 field period of a video signal into two or more subfields, and displays gradation with the combination of this subfield It responds to a count means to count the number of lighting pixels in each subfield, a means to decide the amount of brightness amendments based on the number of lighting pixels in each counted subfield, and this amount of brightness amendments. In each subfield It is characterized by having a means to determine the electrical-potential-difference value impressed to a plasma display panel.

[0011] The subfield conversion approach of the plasma display of this invention In the subfield conversion approach of the plasma display which divides 1 field period of a video signal into two or more subfields, and displays gradation with the combination of this subfield Divide a video signal for every subfield, and in case the lighting information which includes the count of lighting and lighting time amount at least according to gradation is generated, count the number of lighting pixels in a subfield, and brightness amendment information is referred to. The amount of brightness amendments is decided based on the number of lighting pixels in each counted subfield, and it is characterized by determining the maintenance pulse number of each subfield according to this amount of brightness amendments.

[0012] Moreover, the subfield conversion approach of the plasma display of this invention In the subfield conversion approach of the plasma display which divides 1 field period of a video signal into two or more subfields, and displays gradation with the combination of this subfield Divide a video signal for every subfield, and in case the lighting information which includes the count of lighting and lighting time amount at least according to gradation is generated, count the number of lighting pixels in a subfield, and brightness amendment information is referred to. The amount of brightness amendments is decided based on said number of lighting pixels in each counted subfield, and according to this amount of brightness amendments, it is each subfield and is characterized by determining the electrical-potential-difference value impressed to a plasma display panel.

[0013] The plasma display equipment of this invention uses the driving gear or the subfield conversion approach of above-mentioned this invention.

[0014]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is explained using a drawing.

[0015] The block diagram of the driving gear of the plasma display of this invention is shown in drawing 1 . If the digital video signal 1 is inputted into the subfield conversion circuit 2, in the subfield transducer 3 of the subfield conversion circuit 2, the inputted digital video signal will be divided for every subfield, and it will decide on the count of lighting, and lighting time amount according to gradation. Moreover, the subfield transducer 3 counts the number of lighting pixels of each subfield by the renewal of a vertical-synchronization period, i.e., the renewal of 1 field, the maintenance pulse number of each subfield is determined with reference to a brightness amendment table in the brightness amendment section 4 based on the number, and the maintenance pulse generating circuit 7 is controlled. In addition, the subfield transducer 3 serves as a lighting information generation means to generate lighting information, such as a count of lighting, and lighting time amount, according to gradation, and a means to count the number of lighting pixels in a subfield. Moreover, the brightness amendment section 4 serves as a means to decide the amount of brightness amendments based on the number of lighting pixels in each counted subfield, and a means to determine the maintenance pulse number of each subfield according to this amount of brightness amendments. The panel drive circuit 5 is a drive circuit for making a cel turn on from the lighting information for every subfield, a maintenance pulse, etc., and an image is displayed by the panel display 6.

[0016] Therefore, the fall of the discharge current by the increment in the cel to turn on can be

suppressed by control of the number of maintenance pulses, the variation in brightness can be prevented, and, finally a gradation property can be improved. In addition, control of the number of maintenance pulses amends the brightness fall by the fall of the discharge current by controlling the count of discharge.

[0017] The fall of the discharge current may be performed also by controlling the electrical-potential-difference value of a maintenance pulse. The wave provincial accent of a pulse can be improved by raising an electrical potential difference, and a discharge current value can be raised. Of course, the number of the pulses to maintain and control of an electrical potential difference may be combined suitably.

[0018] As a technique relevant to this invention, in JP,5-35205,A, the number of lighting pixels within a certain scan period is counted, and changing the pulse number of the maintenance pulse impressed to that scan lateral electrode according to this number of lighting pixels is indicated.

[0019] A plasma display will hold the data for the 1 field by the subfield conversion circuit for the method which displays by rewriting for every pixel in the unit of a subfield. By this invention, in order to judge the number of lighting cels in 1 screen, the data under this subfield conversion are counted to coincidence, and the number of lightings in a certain subfield passes a result to the brightness amendment section in the form of how many. In the brightness amendment section, a subfield with many the No. 1 lightings is made into importance, and a maintenance pulse number is amended. On the other hand, in above-mentioned JP,5-35205,A, since the number of lighting pixels is counted for every scanning line, there is a point inadequate as brightness amendment of the whole screen. In this invention, in order to perform this brightness amendment for every field, equalization of brightness will improve further.

[0020]

[Example] Hereafter, the example of this invention is explained to a detail using a drawing.

[0021] The circuitry Fig. of one example of the driving gear of the plasma display of this invention is shown in drawing 2.

[0022] As shown in drawing 2, the digitized video signal 1 is inputted into the subfield transducer 3. The subfield transducer 3 consists of the subfield conversion configuration section 31, a counter 32, and latch 33.

[0023] The subfield conversion configuration section 31 changes the digital video signal 1 into the count of lighting and lighting time amount which were doubled with gradation for every subfield. And the subfield conversion configuration section 31 sends the data under subfield conversion to a counter 32 at a counter 32 while outputting the lighting information for every subfield by which subfield conversion was carried out to the panel drive circuit 5. The number of lighting pixels of each subfield counts by renewal of 1 field with a counter 32, and the number of counts is updated for every field by latch 12. In addition, for processing of a counter 32 and latch 33 in the subfield conversion configuration section 31, subfield conversion is carried out and the field memory for delaying the lighting information outputted to the panel drive circuit 5 by the 1 field is prepared if needed.

[0024] The number of counts outputted by the latch 33 of the subfield transducer 3 is inputted into the brightness amendment section 4. The brightness amendment section 4 consists of a comparator 41, an amount detecting element 42 of brightness amendments, and a maintenance pulse number controller 43.

[0025] A comparator 41 judges the number of luminescence cels to the total number of cels from the number of counts of each subfield outputted by latch 33, it combines the amount detecting element 42 of brightness amendments with the external control from a microcomputer etc., determines the amount of brightness amendments, and outputs the number of maintenance pulse amendments. The amount of brightness amendments is obtained from the brightness correction factor alpha. The brightness correction factor alpha sets maintenance pulse augend in case the number of lighting dots is 0 to 0, and if there are many lighting dots, it will increase maintenance pulse augend. The maintenance pulse number controller 43 applies the number of maintenance pulse amendments to maintenance pulse initial value, and outputs a maintenance pulse number to the maintenance pulse generating circuit 7.

[0026] Drawing 3 is drawing showing the ideal relation between the number of lighting dots, and

brightness and a maintenance pulse number. In the number  $N_{\max}$  of lighting dots in the condition of not amending, brightness will fall to  $L_{\min}$  by the fall of the discharge current. At this time, a maintenance pulse is increased from the usual maintenance pulse number  $P_{\text{base}}$ , and it is referred to as maintenance pulse number  $P_{\max}$  in  $N_{\max}$ , and it sets up so that the fall of brightness may be compensated.

[0027] The maintenance pulse generating circuit 7 consists of a selector 71 and a counter 72. A selector 71 chooses a predetermined subfield by the subfield change rate timing pulse, and outputs a maintenance pulse number to a counter 72. A maintenance pulse generation clock is inputted into a counter 72, and the maintenance pulse corresponding to a maintenance pulse number is outputted to the panel drive circuit 5 from a counter 72.

[0028] The panel drive circuit 5 is the lighting information for every subfield from the subfield transducer 3, In order to make a cel turn on from the maintenance pulse from the maintenance pulse generating circuit 7 etc., it is the drive circuit which drives the panel display 6, and the data control gate array 51 of drawing 4 corresponds. Moreover, the panel display 6 consists of data side drivers 61 and 62 of drawing 4, scan side drivers 63 and 64, and a plasma display panel 65.

[0029] The configuration and the drive approach of a panel drive circuit and a panel display are indicated by above-mentioned JP,5-35205,A. The block diagram showing the plasma display equipment containing the panel display by which drawing 4 is indicated by above-mentioned JP,5-35205,A, the timing chart which shows the driving pulse by which drawing 5 is impressed to a plasma display panel, and drawing 6 are timing charts which show the driving pulse impressed to the plasma display panel with which maintenance pulse amendment was performed.

[0030] An example of the drive approach of a plasma display is first explained using drawing 4 and drawing 5. As shown in drawing 4 and drawing 5, an address pulse with a low frequency and the high maintenance pulse of a frequency are impressed to the scan lateral electrode of the plasma display panel 65 connected with the scan side drivers 63 and 64, and these pulses are set to it near the breakdown voltage  $V_f$ . When making a dot (XL, YM) with a plasma display panel 65 turn on, discharge is made to cause by impressing this address pulse and the pulse of opposition to the data lateral electrode XL of the plasma display panel 65 connected with the data side drivers 61 and 62, and impressing the bigger electrical potential difference as a synthetic wave than breakdown voltage  $V_f$ . It will be in the condition that discharge tends to break out under the effect of the charged particle generated once discharge took place, and even if it removes the pulse impressed to a data lateral electrode, discharge continues only by the maintenance pulse.

[0031] When making a dot (XL, YM+1) with a plasma display panel 65 switch off, generating of discharge is suppressed by impressing the address pulse impressed to scan lateral electrode YM+1, and the pulse of an inphase to the data lateral electrode XL, and impressing the electrical potential difference smaller than  $V_f$  as a synthetic wave.

[0032] In this example, as shown in drawing 6, the lighting information for every subfield from the subfield transducer 3 is outputted to the data side drivers 61 and 62 through the data control gate array 51, and the data side drivers 61 and 62 are based on lighting information, and they are the data lateral electrode X1 - Xend. The maintenance pulse drive wave of predetermined applied voltage is impressed. Moreover, the maintenance pulse (maintenance pulse by which the amount of maintenance pulse amendments was applied to maintenance pulse initial value) adjusted from the maintenance pulse generating circuit 7 is outputted to the scan side drivers 63 and 64 through the data control gate array 51, and the scan side drivers 63 and 64 impress the maintenance pulse drive wave of predetermined applied voltage to the scan lateral electrode Y1 - Yend based on a maintenance pulse.

[0033] In the example explained above, although the brightness fall by the fall of the discharge current was suppressed by control of a maintenance pulse number, you may carry out also by controlling the electrical-potential-difference value of a maintenance pulse. The configuration of the driving gear which controls a maintenance pulse-voltage value is the same as the configuration of drawing 2. Of course, the number of the pulses to maintain and control of an electrical potential difference may be combined suitably.

[0034]

[Effect of the Invention] As explained above, according to this invention, by counting the number of lighting cels of each subfield, keeping the intensity level of each cel constant and preventing a brightness fall relatively by controlling dynamically the electrical-potential-difference value impressed to a maintenance pulse number or/and a plasma display, it cannot be dependent on APL (average picture level) of an image etc., and a linear gradation property can be acquired.

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[Translation done.]

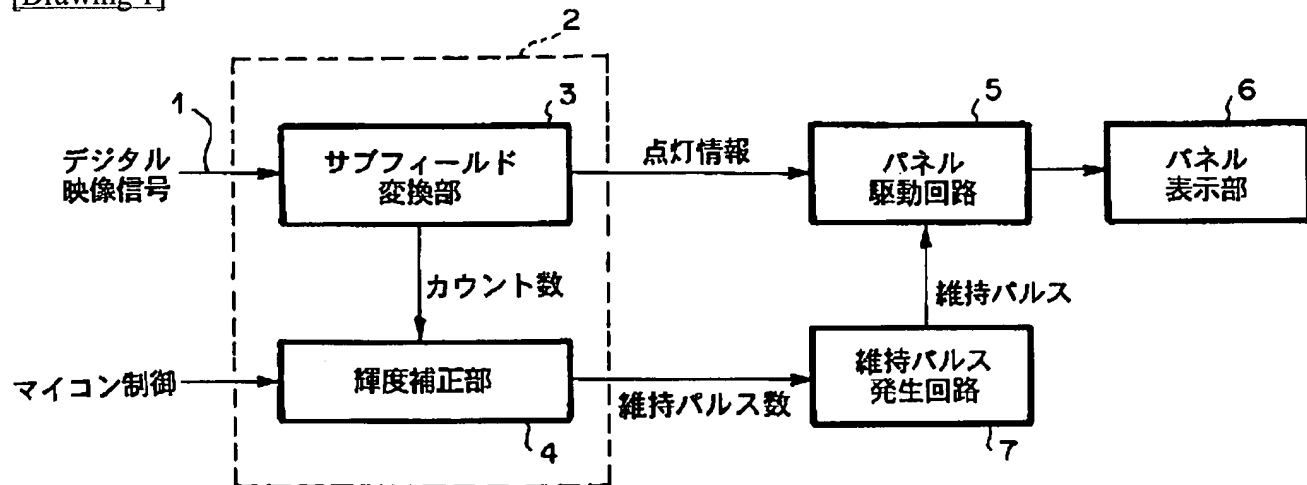
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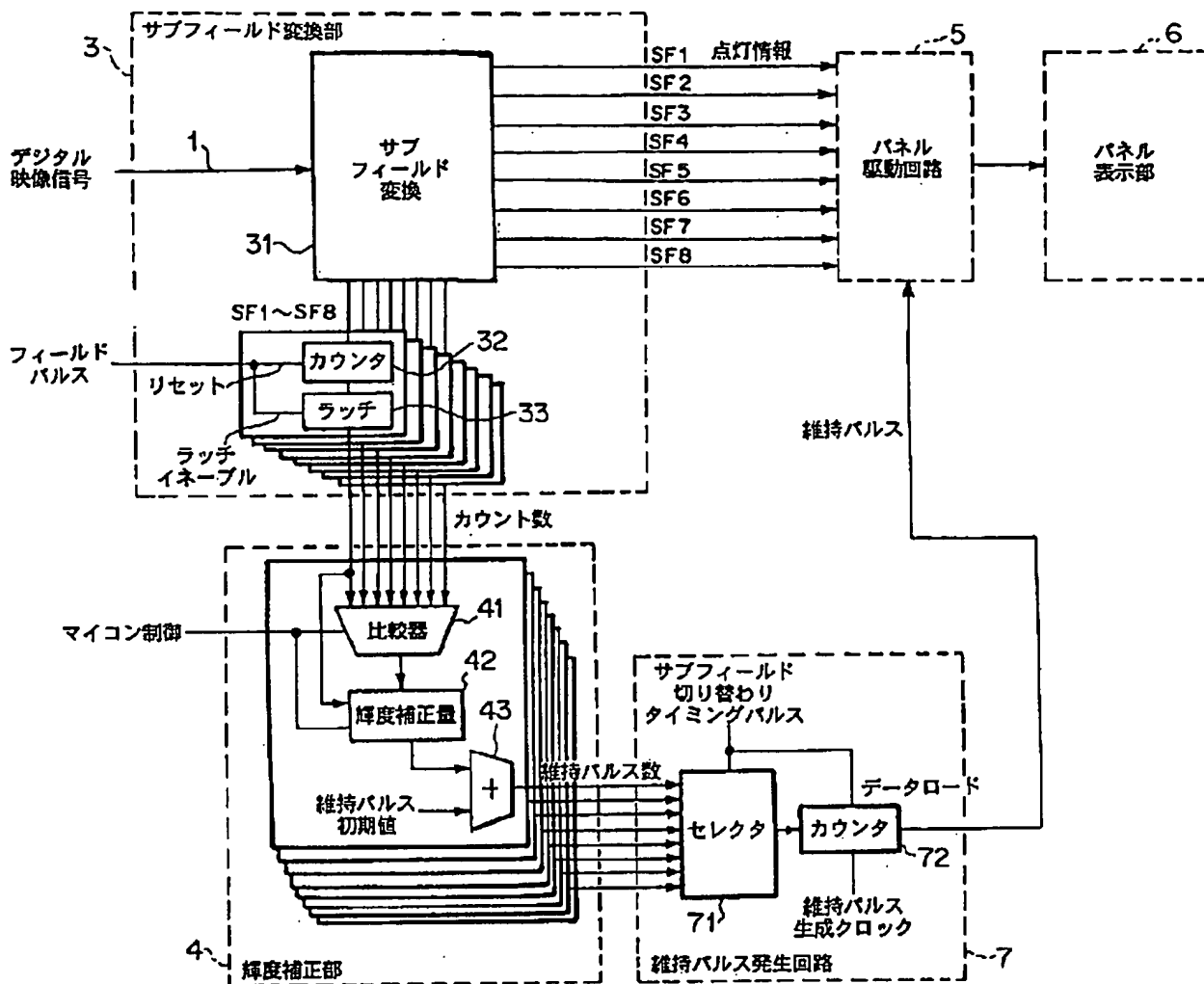
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## DRAWINGS

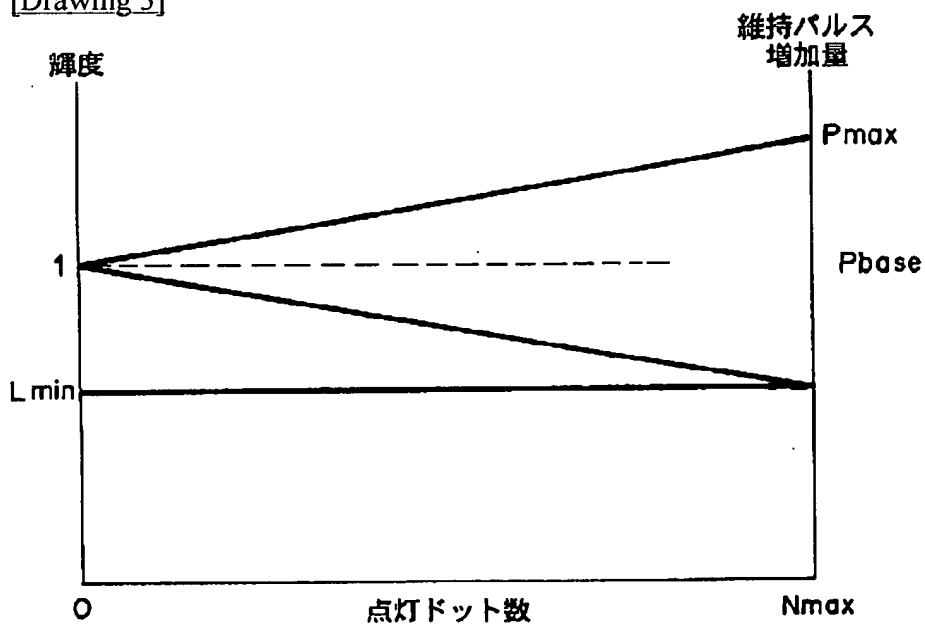
[Drawing 1]



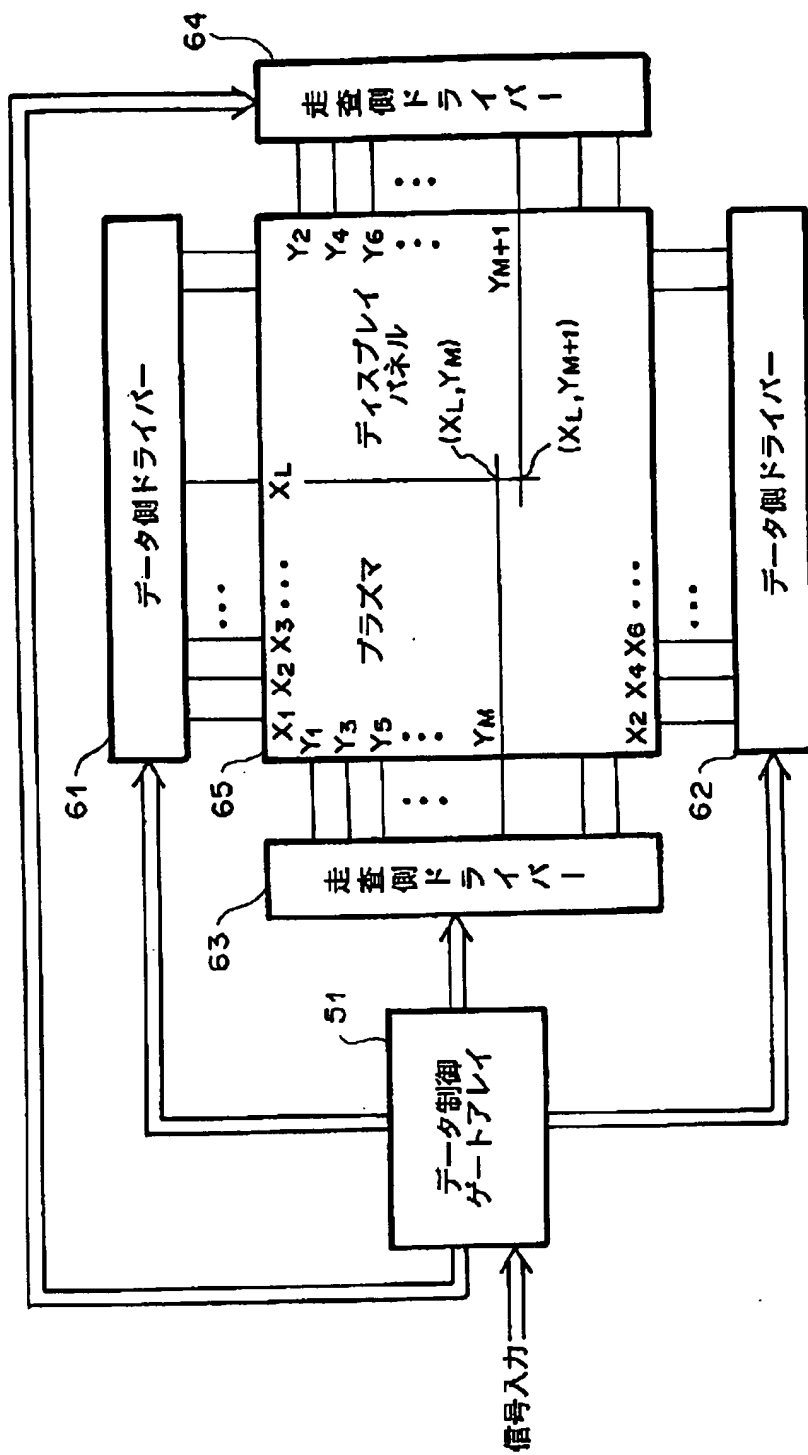
[Drawing 2]



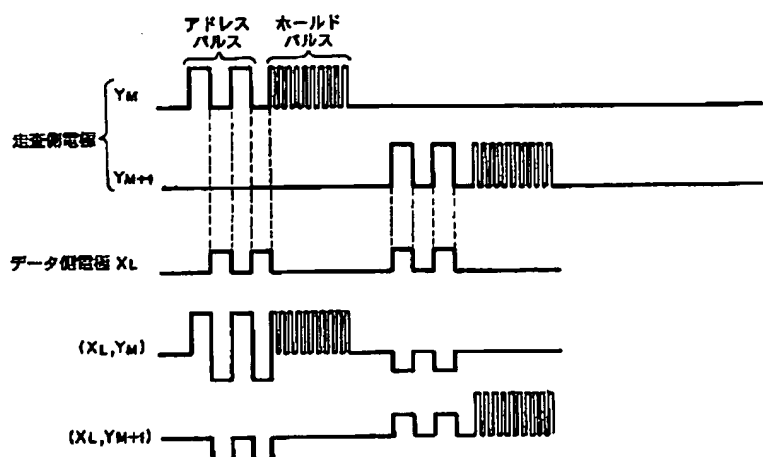
[Drawing 3]



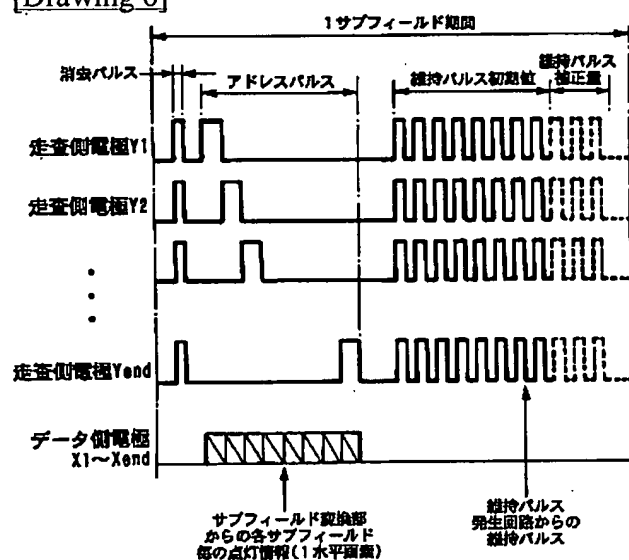
[Drawing 4]



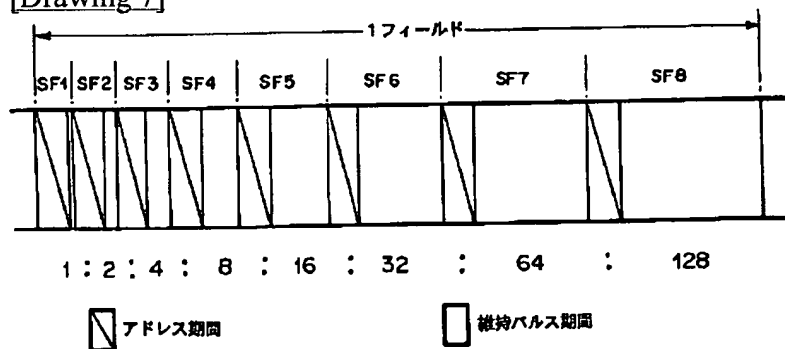
[Drawing 5]



[Drawing 6]



[Drawing 7]



[Translation done.]